

[10191/3714]

PROTECTIVE DEVICE FOR A VEHICLE

Background Information

The present invention is directed to a protective device for a vehicle according to the definition of the species in the independent claim.

A safety device for motor vehicles is known from Offenlegungsschrift DE 199 60 179 A1. The motor vehicle has one airbag or multiple airbags in this case which can be deactivated via switching means. The switching means are designed here in the form of a deactivation switch.

Advantages of the Invention

The protective device for a vehicle according to the present invention having the features of the independent claim has the advantage over the related art in that, in addition to analyzing the switch position using a processor, another module for analyzing the switch position is present which functions independently from the processor. A hardware redundancy is thereby established. For its function, this module advantageously has at least one logic module. It is possible to provide delay times and hold times of any length for the module's logic state time-variant approaches by using such logic modules. Tolerances are now irrelevant due to the use of logic modules. Long delay times and hold times of a few hundred milliseconds are easily implementable due to the use of logic modules.

The measures and refinements cited in the dependent claims make advantageous improvements on the protective device for a vehicle cited in the independent claim possible.

It is particularly advantageous that the at least one logic module is designed as a gate and/or as a flip-flop. In order to make the particular length of the delay times and hold times of the module's logic state possible, a combination of different gates and flip-flops may be provided. A freeze-in of the logic result in particular is thus possible.

Furthermore, it is advantageous that the at least one logic module is configured in such a way that a time response of the logic module's logic state is variable. This may be carried out in particular via the processor, which, however, exerts no influence on the module's analysis of the signal from the switch. The time response refers to the delay times and the hold times of the logic state.

Furthermore, it is advantageous that the switch is designed either as a resistor network or as at least one Hall sensor. These are two reliable circuit concepts for a switch.

In addition, it is advantageous that the power supply of the switch is provided either from the control unit, e.g., for the restraint systems, i.e., the protective device, or that an external power supply of the switch is made available which makes a direct connection to the vehicle battery possible.

Finally, it is also advantageous that an AND gate is provided, gating together a signal of the module and a signal of the processor, so that only in the case of a logic 1 of both inputs is a new output signal of the module relayed.

Drawing

Exemplary embodiments of the present invention are illustrated in the drawing and are explained in greater detail in the description below.

Figure 1 shows a first block diagram of the protective device according to the present invention, and

Figure 2 shows a second block diagram of the protective device according to the present invention.

Description

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In today's vehicles the possibility is provided for deactivating the passenger-side airbag or the rear side airbags using a switch, i.e., an airbag deactivation switch. For this purpose, the position of a key switch, for example,
10 is analyzed by the airbag control unit. Different concepts are possible for implementing the switch. Switches, having resistor networks where the switch switches between two different resistor dividers, and switches made up of one or two Hall sensors are commonly used. These are switched without
15 contact, which results in high mechanical robustness.

Since the airbag deactivation function is safety-critical, the analysis in the airbag control unit is normally designed to be redundant. Analysis of the switch position and activation or
20 deactivation of the airbag(s) are normally carried out via software and via a hardware path which is independent from the microcontroller. Depending on the switch position, this hardware path or module additionally activates or deactivates the respective restraining means -- triggering circuits for
25 airbags, seatbelt tensioning devices, or other restraining means such as, for example, an electromagnetic valve for a roll bar -- via the hardware, thereby ensuring that erroneous triggering of the respective triggering circuits is not possible, even in the event of a defective microcontroller.

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The required hardware path or modules must perform the following functions:

- Analyzing the signal lines of the deactivation switch
- Filtering the signals
- 35 - Processing the signals
- Detecting and handling errors, i.e., a defect in the switch, interruption of the battery supply
- Determining default states after switch-on
- Defining the time response: timeouts, hold times, and delays

- Activating or deactivating the defined triggering circuits via hardware intervention

- Responding to switch-off of the airbag control unit.

Attention should be paid to the fact that, after the battery supply is switched off, the control unit still draws power for some time from its own power reserve.

Possible implementations of this module in the airbag control unit are discrete circuits having operational amplifiers and/or comparators for processing the respective input signals of the airbag deactivation switches, and for triggering suitable activation circuits and deactivation circuits.

Activation and deactivation of the restraining means may take place in different ways:

- Switching on and off the supply voltage of the respective triggering circuit IC's

- Switching on and off the trigger voltage supply for the respective triggering circuits

- Interrupting the triggering circuits, shorting the triggering circuits to ground, or shorting the ignitor

- Intervening in the logic control of the triggering circuits, in or at the triggering circuit IC.

Signal filtering and time response of the circuit during normal operation, as well as in the event of an error, are implemented by suitable circuit elements. RC elements are possible here, but they have disadvantages. Such disadvantages are: time invariance, i.e., only a certain time response is possible; it is not possible to differentiate between different operating states; there are relatively great tolerances; dimensioning, availability, and the size of resistors and capacitors are limited, and in particular, delay times and hold times longer than a few hundred milliseconds are difficult to implement.

According to the present invention, the redundant hardware path is implemented by using logic modules. Such logic modules include gates and flip-flops, i.e., multivibrator circuits.

These make it possible to achieve time-variant approaches with delay times and hold times of any length. The microcontroller or processor may assume the time control of the logic modules. In this case, however, the processor has only the possibility to control the time response of the module for analyzing the state of the airbag deactivation switches, but not the state of the restraining means activation or restraining means deactivation. This is important to preserve the concept of redundancy.

Figure 1 shows the protective device according to the present invention in a first block diagram. The protective device according to the present invention has an airbag deactivation switch 1 and an airbag control unit 4 which are connected to one another. Airbag deactivation switch 1 has two Hall sensors 2 and 3 which are interconnected on an electrode where they receive power from control unit 4 and a current limiter 6. Current limiter 6 itself is supplied by battery voltage 5. On the other side, Hall sensor 2 is connected to two components of control unit 4. One is a module 7 which includes the voltage supply, communication interfaces, analog inputs, and an analog-to-digital converter; the other is a module 8 which processes and analyzes the signal of Hall sensor 2. Processing of the sensor signals forks into two paths here. The digitized Hall signal is transmitted to microcontroller 9 via module 7, the microcontroller processing the signal to determine whether the deactivation switch has been operated or not. At the same time, module 8 performs the same procedure, module 8 also having access to an analog-to-digital converter in order to execute a digital analysis. The other electrode of Hall sensor 2 is also connected to module 7 and module 8 to make redundant processing of the Hall sensor signals possible here also.

Processor 9 activates or deactivates the deployment of the restraining means via software according to the switch position of deactivation switch 1. One or both Hall sensor signals are filtered and analyzed in module 8. This is followed by triggering of safety semiconductor 13 via hardware for activating or deactivating the appropriate triggering circuits. However, block 10 and block 11 are also switched

between these two procedures. Block 10 enables the activation of the airbag triggering circuits as a function of the status of the deactivation switch and combines this with an additional enable signal from processor 9. This makes it possible not to enable airbag output stages 12 by processor 9 before, in the event of a crash, deployment should indeed take place, regardless of whether the deactivation switch is in the "on" or "off" position. However, due to block 10, microcontroller 9 has the possibility to activate output stages 12 via safety semiconductor 13 only when deactivation switch 1 is also in the "on" position. If deactivation switch 1 is in the "off" position, then output stages 12 are deactivated independently of the processor enabling line to block 10. Particularly in airbag control units having a DC ignition, this function represents an additional protection against erroneous deployment in the event of defects in output stage IC 12. It is alternatively possible to omit block 10. The output signal of block 10 is supplied to a block 11 which represents a logic circuit unit and which may be implemented using flip-flops. This block enables storage and freezing-in of the deactivation switch state. The storage is volatile, i.e., it is not preserved when the airbag control unit is switched off. Processor 9 has the possibility to control whether the logic state of safety semiconductor 13 and thus the activation or deactivation of the respective airbag triggering circuits 15 through 18 is frozen, thereby becoming independent of possible changes in the switch position of deactivation switch 1, or whether each change in the switch position instantaneously results in activation or deactivation of airbag triggering circuits 15 through 18. Here again, it is important that processor 9 is only able to freeze-in the state of safety semiconductor 13, but has no bearing on the state itself. Varied and very flexible options for controlling the analysis of deactivation switch 1 arise from this concept of logic storage or freezing-in of the state of the hardware path, such as:

- any hold times or delay times are possible,
- in the event of an error, a crash, or a power reserve problem, the state of the hardware path may be frozen,

- it is possible to control whether the state of deactivation switch 1 is read in and received only once at the start of a closing cycle, or whether a change in the switch position is permissible at any time.

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As mentioned before, block 11 is connected to safety semiconductor 13, which is in turn connected to power reserve 14 and output stages 12. Power reserve 14 is normally at least one capacitor which, in the event of an interruption of the battery connection, supplies power for a certain amount of time for continued operation. Processor 9 is directly connected to output stages 12 via a data output to control the output stages via software. Output stages 12 are connected to triggering circuits 15 through 18, respectively. As described above, processor 9 itself is connected to block 10 via an enable line to establish an AND gate, as well as to block 11 to influence the time response.

Safety semiconductor 13 is normally a transistor switch.

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The protective device according to the present invention has the advantage that it is independent of the design of deactivation switch 1, i.e., it does not matter whether it is a resistor network or one or two Hall sensors. Furthermore, the protective device is independent of the type of supply of deactivation switch 1. It is also independent of whether the hardware path analyzes only one Hall sensor and/or one resistor network, or two or multiple Hall sensors and/or resistor networks. It is furthermore independent of the type of restraining means to be deactivated. The present invention is also independent of the type of deactivation of the restraining means, i.e., whether it is a question of switching on and off the supply voltage of the respective triggering circuit IC's, or switching on and off the trigger voltage supply, or interrupting the triggering circuits, or shorting the triggering circuits, or intervening in the logic control of the triggering circuits. The present invention is also independent of whether the position of deactivation switch 1 is input in the software part via a separate IC or directly by the microcontroller, i.e., there is an A/D converter in the

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microcontroller itself. The order of blocks 10 and 11 may also be exchanged.

Figure 2 shows a second block diagram of the protective device according to the present invention. Except for the power supply of deactivation switch 19, deactivation switch 19 and control unit 21 have the same elements. A current limiting unit 20 or fuse is situated directly at deactivation switch 19, thereby externally supplying the deactivation switch. The other elements are situated and indicated exactly as in Figure 1.